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USE OF BOTTLED-GAS VEHICLES IN UKRAINIAN SSR

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The introduction of trucks operating on bottled gas took place in Ukraine in 1938 - 1939. However, the war interrupted the plans for a more extensive development of this type of vehicle.

After the liberation of the Ukraine, the government of the Ukrainian SSR adopted a number of measures for the resumption of efforts in this direction. In 1945, the Kiev Oblast Automobile Trust set up a gas-distributing station and refitted more than 100 trucks, to be powered by liquefied gas. In the following years, more than 500 trucks in Kiev and other cities of Kiev Oblast were thus refitted.

In 1946, the entire automobile park of the Drogobych Oblast /Automobile/ Trust was refitted. Later, the parks of many other automobile trusts of the Ministry of Motor Transport Ukrainian SSR -- for example, the Transcarpathian and Stanislav /automobile/ trusts -- as well as the automobile managements of other departments were similarly refitted.

In the Motor Transport Office of the Zaporozh'ye Oblast /Automobile/ Trusts and the Melitopol' Methane Base, which are situated 45 kilometers from the nearest gas-distributing station, at Priazovskoye, an original and simple method of supplying vehicles with compressed gas is being employed. Easily removable flasks are mounted in vehicles in batteries of four to six. These batteries are dispatched in groups on two-axle truck-trailers to the Priazovskoye station to be filled with compressed gas. The full flasks are then put into storage and as the need arises are mounted on the truck between the bed and the cab.

In 1947, the Ukravtogaz Trust was organized under the Ministry of Motor Transport Ukrainian SSR. It re-established all the gas filling stations, built the new No 1 station in Kiev, and began construction of another station, No 2, in Kiev. At the same time, the trust manufactures gas-reducing equipment, refits trucks, and supervises the operation of gas-powered trucks.

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In the Ukraine, vehicles powered by gas flasks are currently operating not only on liquefied gas (butane and propane mixtures) but also on natural compressed, industrial coke, and enriched coke (synthesized) gases. Since the beginning of 1950, hundreds of gas-flask ZIS-156 and GAZ-51-B trucks have been operating on compressed gas in many cities of the Ukraine. The Gorlovka, Makeyevka, Priazovskoye, and Stalino No 1 stations, which were destroyed during the war, were rebuilt with a view to increasing their original capacity. Everywhere, except at Azovskoye, an additional compressor was installed. At some stations, the batteries having a working capacity of 200-220 atmospheres were replaced with batteries of 350 atmospheres. At all stations, the number of batteries was increased from two to eight, each having a water volume of 1,000 liters (except the Priazovskoye station, whose battery has a volume of 400 liters). Each of the stations, excepting the Priazovskoye, has two 4-step compressors in operation, each compressor yielding 180 cubic meters of gas per hour under a working pressure of 350 atmospheres.

These compact vertical compressors, which are easy to assemble and disassemble, permit a rational utilization of space and are easy to operate. They should be installed in the stations now under construction. However, four compressors instead of two ought to be installed in each station. Stations dispensing natural gas have no need for counterpressure valves to maintain a pressure of 350 atmospheres.

The operation in the Donbass of gas filling stations dispensing industrial gas is a question that requires further study. However, it is becoming clear that the stations can hardly be operated at a profit if the city network is supplied with gas that has been inadequately cleaned and if the stations themselves are not equipped with gas-cleaning and methanating apparatus for the enrichment of low-calorie coke gas.

After trying out various types of gas flask equipment, the Avtogazapparat Plant has begun to produce an improved type of two-step reducing apparatus with a vacuum discharger, similar to that currently installed in ZIS-156 and GAZ-51-B trucks. This equipment has yielded excellent results and improved the operation of gas-powered vehicles. It has decreased the rarefaction of gas upon leaving the reducer and enabled regulation of the reducer even during a positive fall in pressure.

The data resulting from the operation of vehicles on compressed natural gas and liquefied gas since 1945 show that the high antiknock and low carbonization qualities of gas fuels and the elimination of thinning in crankcase oil have prolonged the service of engines prior to maintenance and major repairs 1.4 to 1.5 times.

The high qualities attributed by many research workers to gas fuel are generally not obtained in actual practice, and in cold weather it is necessary to start the engine with the help of gasoline even when the oil is drawn off and warmed up.

Gas-operated engines, whatever their make, consume on the average 25-30 percent more oil than engines using gasoline.

The following power losses have been calculated for engines using different gases: Dashev compressed natural gas, 7-8 percent; liquefied gas, 4-5 percent; compressed synthetic gas, 12-14 percent; compressed coke gas, 20 percent and more. In practice, these losses are imperceptible in the case of liquefied gas, are slightly perceptible with natural gas, are within permissible limits with synthetic gas, and lower considerably a vehicle's traction capacity with coke gas. The coke gas employed at present is not sufficiently clean, containing naphthalene, hydrogen sulfide, tar, and benzene impurities, which frequently put the reduction system, valves, and gas lines out of order. The relatively low calorie content of

of coke gas puts sharp limitations on a vehicle's power reserve. In this case, the power could be increased if the ordinary cylinder block head of the gasoline engine were replaced with that of the gas-generator type, especially in GAZ-M and ZIS-5 engines, which have low compression.

An analysis of the economics of gas-powered vehicles requires consideration of the basic cost per kilometer and ton-kilometer indexes. The provisional gas-consumption norms per 100-kilometer runs, established by the Ministry of Motor Transport Ukrainian SSR, are realized in the operation of gas-powered vehicles, as shown in Table 1 below. Table 2 shows fuel costs per ton-kilometer and kilometer run.

Table 1

Fuel Consumption per 100-km Run

Type of Gas	GAZ-AA	GAZ-51	ZIS-5	ZIS-150
Liquefied (kg)	16.5	21	27	30
Natural (cu m)	21	27	35	40
Synthetic (cu m)	34	44	56	63
Coke (cu m)	42	53	70	77

Table 2

Cost (kopecks)

	Per Kilometer Run				Per Ton-Kilometer Run			
Type of Gas	GAZ-AA	ZIS-5	GAZ-51-B	ZIS-156	GAZ-AA	ZIS-5	GAZ-51-B	ZIS-156
Liquefied	14.85	18.9	--	--	9.9	7.56	--	--
Natural	14.7	24.5	18.9	28.0	12.2	11.4	9.45	11.66
Synthetic	18.7	30.8	20.2	34.65	17.0	13.1	12.1	14.15
Coke	21.0	35.0	25.5	38.5	19.01	15.0	13.25	15.7

The fuel consumption of the flask-equipped GAZ-51-B and ZIS-150 trucks is the same as that of the GAZ-51 and ZIS-150 trucks which have been refitted to operate on compressed gases. The fuel distance covered by gas-powered vehicles depends on the number of flasks installed and the calorie content of the gas, as shown in the table below.

Table 3

Type of Gas	No of Flasks						Fuel Distance Covered by One Filling (km)					
	GAZ-AA	GAZ-51	ZIS-5	ZIS-150	GAZ-51-B	ZIS-156	GAZ-AA	GAZ-51	ZIS-5	ZIS-150	GAZ-51-B	ZIS-156
Liquefied	1	1	2	2	--	--	270	215	330	300	--	--
Natural	4	6	6	6	6	8	219	255	197	161	255	230
Synthetic	5	6	7-8	7-8	6	8	170	156	143-164	128-146	157	145
Coke	5	6	7-8	7-8	6	8	136	130	115-131	109-120	130	120

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The gas flasks have the following specifications: flasks for compressed gas have a water volume of 50 liters, a working pressure of 200 atmospheres, and a weight of 70-75 kilograms; flasks for liquefied gas have a gas weight capacity of 45 kilograms, a working pressure of 16 atmospheres, and a weight of 46-50 kilograms.

The actual cost per kilometer and ton-kilometer run is still high and should be reduced 30-40 percent within the next 2 years. In that event, the cost per run of vehicles that are gas-powered will be 20-30 percent lower than that of gasoline-operated vehicles. This should yield an average yearly fuel saving of 2,000-2,500 rubles per vehicle for a run of 30,000 kilometers.

Experience in the operation of gas-powered vehicles has shown that engine runs between repair periods have increased 1½ times, which results in an average annual saving of 2,500-3,000 rubles.

Vehicles in the Ukrainian SSR which have been converted from gasoline to gas are hardly distinguishable, insofar as their equipment is concerned, from the ZIS-156 and GAZ-51-B trucks. The reduction system in the ZIS-156 and GAZ-51-B trucks, which is put out by the Moscow Carburetor Plant, is very close to the P-2 system produced by the Avtogazapparat Plant, and is used both for compressed and liquefied gases. The control system of the P-2 reduction system is the same as that used in the gas-powered ZIS-156 and GAZ-51-B trucks.

It is also proper to point out a number of shortcomings which have become apparent in the equipment of gas-powered ZIS-156 and GAZ-51-B trucks:

1. The brass piston rod face, against which the steel crank lever moves in the high-pressure chamber, wears out quickly. This impedes normal operation in the chamber.

2. The cast nonferrous-metal oxygen valves are not sufficiently wear-resistant and permit gas to seep through the stem. These should be stamped from ferrous metals.

3. The flasks are mounted in series. This is undesirable, since in event a gas line is broken, the entire section is put out of order.

Experience acquired in the operation of gas-powered vehicles indicates that if these are to play a part in the national economy, it will first be necessary to establish a wide network of filling stations for the distribution of natural, industrial, and liquefied gases.

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